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ATTORNEY DOCKET: PD-02W189

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Utility Application of:

Robin A. **REEDER**, et al.

Serial No.:	10/720,328	:	Group Art Unit:	2828
Filed:	November 24, 2003	:	Examiner:	NGUYEN, Dung T.

For: **SLAB LASER AND METHOD WITH IMPROVED AND DIRECTIONALLY HOMOGENIZED BEAM QUALITY**

Commissioner of Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

AFFIDAVIT UNDER 37 CFR 1.131

Sir:

We, Robin A. Reeder, David M. Filgas and Robert W. Byren, hereby declare that we are the inventors of SLAB LASER AND METHOD WITH IMPROVED AND DIRECTIONALLY HOMOGENIZED BEAM QUALITY disclosed and claimed in the above-identified Patent Application.

Enclosed herewith is a copy of an Invention Disclosure, which shows that the invention was conceived by us on or before October 1, 2002. We worked diligently on the invention from conception until the application was filed November 24, 2003, as evidenced by the following:

1) Invention Disclosure entitled "Slab Laser and Method Improved and Directionally-Homogenized Beam Quality" (pages 3 and 4, containing proprietary business information, have been removed);

2) E-mail message letter from assignee (Raytheon) Patent Administrator notifying inventors of Patent Committee rating dated November 5, 2002;

3) Letter from Outside Counsel dated April 1, 2003 forwarding first draft of Patent Application to inventor for review;

4) Receipt of email dated June 13, 2003 with inventor comments;

5) Letter dated October 16, 2003 from Outside Counsel forwarding final draft of the Patent Application with formal drawings for filing with the USPTO.

These documents show that the invention disclosure was sent to Outside Counsel on November 5, 2002 for the preparation of a Patent Application. Due to the attorney's backlog of unrelated cases, the case was taken up in chronological order, prepared and filed expeditiously. That is, a first draft was prepared on April 1, 2003. The inventor provided comments on the draft on June 13, 2003. Outside Counsel reviewed the comments, revised the draft and sent a final draft to the Assignee (Raytheon) on October 16, 2003. The Patent Application was filed on November 24, 2003.

Our conception and work on the invention occurred in the United States of America.

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We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
Robin A. Reeder	Robin A. Reeder	6/12/06
RESIDENCE (CITY AND STATE)		**CITIZENSHIP**
El Segundo, California		USA

FULL NAME OF JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
David M. Filgas	David Filgas	6/12/06
RESIDENCE (CITY AND STATE)		**CITIZENSHIP**
Newbury Park, California		USA

FULL NAME OF JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
Robert W. Byren		6/12/06
RESIDENCE (CITY AND STATE)		**CITIZENSHIP**
Manhattan Beach, California		USA

Raytheon

Invention Disclosure Questionnaire

10-5876-2PC (5/00)

Raytheon Proprietary

Complete the information in the spaces provided. Use the TAB key to advance to the next field. Shift-TAB will move the cursor back one field. Either X or Space-bar can be used to check boxes where required.

Prepare the Invention Disclosure Form, except for the information on page 3. The original should be signed and witnessed where indicated. Send the original and three copies directly to the Regional Patent Engineer (see below). Have a copy reviewed and annotated by your department manager (through your immediate supervisor), and then by the manager of the program office or business area most likely to benefit from protection (via patent or trade secret) of your invention. Once you receive the appropriate comments and signatures, the executed copy and six additional copies should also be sent to the Regional Patent Engineer at (see attached instructions):

Inventors at ELCAN, ROSI, and sites in CA or AZ: Intellectual Property & Licensing Dept., Raytheon Company, 2000 East El Segundo Blvd (EO/E01/E150), El Segundo, CA 90245; Texas area: Intellectual Property & Licensing Dept., Raytheon Company, 13510 N. Central Expressway, M/S 200, Dallas, TX 75243; Northeast Region: Intellectual Property & Licensing Dept., Raytheon Company, 141 Spring Street, Lexington, MA 02421.

1. TITLE OF INVENTION

Slab Laser and Method with Improved and Directionally-homogenized Beam Quality

2. INVENTOR(S) (If more than 3, identify additional inventors in Section 14 and check this box ☐)

(A) NAME (first, middle, last)	EMPLOYEE ID	PHONE	FAX NO.	COMPANY & SEGMENT	DEPT NUMBER
Robin A. Reeder	HAC51803	310-647-3259	310-647-3250	S&AS Engineering	23-C7-25
HOME ADDRESS (street, city, state, zip) 325 E. Oak Ave. El Segundo, CA 90245		CITIZENSHIP USA	COMPANY MAIL/ADDRESS Raytheon, Electronic Systems P.O. Box 902 El Segundo, CA 90245 Building E1, M/S D109		
E-MAIL: rareeder@raytheon.com		MANAGER Flora Yeung			

(B) NAME (first, middle, last)	EMPLOYEE ID	PHONE	FAX NO.	COMPANY & SEGMENT	DEPT NUMBER
David M. Filgas	1027370	310-647-4425	310-647-3250	S&AS Engineering	23-C7-25
HOME ADDRESS (street, city, state, zip) 3823 Claire St. Newbury Park, CA 91320		CITIZENSHIP USA	COMPANY MAIL/ADDRESS Raytheon, Electronic Systems P.O. Box 902 El Segundo, CA 90245 Building E1, M/S D109		
E-MAIL: dmfilgas@raytheon.com		MANAGER Flora Yeung			

(C) NAME (first, middle, last)	EMPLOYEE ID	PHONE	FAX NO.	COMPANY & SEGMENT	DEPT NUMBER
Robert W. Byren	HAC57569	310-647-1375	310-647-0606	S&AS Engineering	23-C7-10
HOME ADDRESS (street, city, state, zip) 2001 Agnes Road Manhattan Beach, CA 90266		CITIZENSHIP USA	COMPANY MAIL/ADDRESS Raytheon Company P.O. Box 902 El Segundo, CA 90254 Building E1, M/S D125		
E-MAIL: rwbyren@raytheon.com		MANAGER C. T. Hastings,Jr.			

Patent Department will determine legal inventorship

3. PROOF OF CONCEPTION

A. BY WHOM WAS FIRST DESCRIPTION WRITTEN OR DRAWING MADE?	DATE CONCEIVED	ACCT. CHARGED (TIME/MATERIAL)	LOCATION OF FIRST DESCRIPTION / DRAWING (TECHNICAL NOTEBOOK NO. AND PAGES)
Robin A. Reeder	7/30/02	Own Time	Patent file in R. W. Byren's office E1/A1255j

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	DATE RECEIVED	PATENT DOCKET NUMBER
Slab Laser and Method with Improved and Directionally-homogenized Beam Quality		

B. TO WHOM WAS INVENTION FIRST DISCLOSED?	DATE DISCLOSED	MANNER OF DISCLOSURE
Douglas A. Anderson	8/02	Robert Byren described optical layout of inventive slab laser resonator to Douglas A. Anderson using first drawing by Robin Reeder cited above.

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Slab Laser and Method with Improved and Directionally-homogenized Beam Quality	DATE RECEIVED	PATENT DOCKET NUMBER
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TITLE OF INVENTION

Slab Laser and Method with Improved and Directionally-homogenized Beam Quality

INVENTOR(S) (Additional Inventors may be listed in Section 14)

Robin A. Reeder	David M. Filgas	Robert W. Byren

12. PUBLICATION, SALE, OR PUBLIC USE

A. HAS THE INVENTION BEEN DISCLOSED TO A THIRD PARTY WITHOUT THE EXECUTION OF A NON-DISCLOSURE, PROPRIETARY, OR OTHER CONFIDENTIALITY AGREEMENT?	YES ☐ NO ☒	DATE	TO WHOM
B. HAS THE INVENTION BEEN USED, DISCUSSED, DEMONSTRATED OR OTHERWISE DISCLOSED OUTSIDE THE COMPANY (SUCH AS TO A VENDOR OR CUSTOMER)?	YES ☒ NO ☐	DATE 8/15/02	TO/FOR WHOM (COMPANY/PERSON) withheld
C. HAS THE INVENTION BEEN SOLD OR OFFERED FOR SALE?	YES ☐ NO ☒	DATE	TO WHOM
D. IS THERE A PUBLICATION OR PUBLIC PRESENTATION RELATED TO THE INVENTION? (This includes the Internet)	YES ☐ NO ☒	DATE	IDENTIFY
E. HAS A MANUSCRIPT DESCRIBING THE INVENTION BEEN SUBMITTED FOR PUBLICATION?	YES ☐ NO ☒	DATE	TO WHOM
F. IF THE ANSWER TO E. WAS YES, HAS THE MANUSCRIPT BEEN ACCEPTED FOR PUBLICATION?	YES ☐ NO ☐	DATE	WHEN AND WHERE WILL IT BE PUBLISHED?

INVENTOR(S) SIGN AND DATE: 10/1/02 Robin A. Reeder 10/1/02 David Filgas 10/1/02

WITNESS NAME (PRINT)	WITNESS SIGNATURE	DATE	WITNESS NAME (PRINT)	WITNESS SIGNATURE	DATE
Maurice J. Holmes		10/03/02	Douglas A. Anderson		10/1/02

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Slab Laser and Method with Improved and Directionally-homogenized Beam Quality	DATE RECEIVED	PATENT DOCKET NUMBER

13. SUMMARY OF THE INVENTION

A. STATEMENT OF THE PROBLEM SOLVED BY THE INVENTION

This Invention addresses the problem of achieving uniform high beam quality in both transverse dimensions of a compact high aspect slab laser. It also addresses the problem of generating short-duration Q-switched pulses in a low-Fresnel number resonator, where the length of the resonator is determined by mode discrimination associated with the broad dimension of a high-aspect slab.

B. PRIOR ATTEMPTS OF OTHERS TO SOLVE THIS PROBLEM

Low-order transverse mode operaton is typically achieved in a stable laser resonator by providing a limiting aperture sized to achieve a low Fresnel number. Intracavity telescopes are typically used in such laser resonators to demagnify the limiting aperture and reduce the effective Fresnel number. Because a high-aspect laser slab is broader in one transverse dimension, achieving low Fresnel number operation along this direction requires a long resonator length. This approach has two fundamental disadvantages: (1) the long length of the resonator results in a large physical volume for the laser resonator and (2) the buildup time in a long resonator is slow, leading to long Q-switched pulse durations. Furthermore, because the transverse mode selection for the two orthogonal directions is decoupled, the resonator may produce a beam with a different beam quality in each direction, which is undesirable for certain applications. A low order mode in the broad dimension of the slab can also be achieved using an unstable resonator configuration, in which the outcoupling is achieved for example by varying the reflectivity of an outcoupler mirror across the transverse dimension. The unstable resonator approach cannot be used with cavity dumping, thereby limiting its utility for certain pulsed applications of interest, such as short-duration pulsed illuminators.

C. HOW YOUR INVENTION SOLVED THIS PROBLEM

This Invention rotates the laser beam between successive round-trip passes such that the transverse mode selection is the same for the two orthogonal directions. The beam quality for both transverse directions is determined by the mode discrimination characteristics of the thin dimension of the slab and therefore can produce high beam quality in both directions without a long resonator. Also, the short resonator allows rapid buildup of the laser pulse in a Q-switched configuration resulting in desirable short-duration pulses.

D. WHY YOU BELIEVE THAT THE INVENTION IS NEW (Specifically point out all novel features)

This is believed to be the first application of a porro prism rotated 45 degrees with respect to the principal axes of a high aspect slab laser to rotate the image on successive round trip passes in order to improve and homogenize the beam quality of a laser system.

A keyword patent search was performed using the following Boolean logic: abst/(laser and (resonator and (twisted or folded)); abst/(laser and prism and ((porro or roof)); abst/(laser and Fresnel). This search yielded 135 hits. Of these, none were remotely related to the present invention.

14. DETAILED DESCRIPTION.

Use the Invention Disclosure Continuation Sheet to provide a detailed written description of your invention, using as many pages as necessary. Be certain to include a description of the "best mode" or best means of practicing the invention known to you at this time. You may insert figures, tables, and photos into this section, or you can attach copies of relevant proposals, prior art, or other documentation that will assist the Patent Evaluation Committee in fully considering your invention. (Note: Please place information on additional inventors first in this section).

INVENTOR(S) SIGN AND DATE: 10/1/02 Robert C Reedy 10/1/02 David Filgas 10/1/02

WITNESS NAME (PRINT)	WITNESS SIGNATURE	DATE	WITNESS NAME (PRINT)	WITNESS SIGNATURE	DATE
Maurice J. Helmos		10/3/02	Douglas A. Anderson		10/2/02

PATENTS AND LICENSING USE ONLY

	DATE RECEIVED	PATENT DOCKET NUMBER
Slab Laser and Method with Improved and Directionally-homogenized Beam Quality		

Raytheon | Invention Disclosure Detailed Description | Raytheon Proprietary

10-5876-3PC (5/00)

Background of Invention:

High power solid-state lasers are useful in a number of military and commercial applications, and many of these require high beam quality in order to achieve high intensity on a target. Many such applications also require short pulses, in the nanosecond regime. The military applications include rangefinders, designators, active tracking illuminators, beacons for atmospheric wavefront sensing, laser radar, infrared countermeasures, and directed energy weapons. The commercial applications include industrial materials processing, long-range remote sensing, and scientific.

One approach to scaling solid-state lasers to higher power involves using a high-aspect rectangular slab geometry for the solid-state laser gain medium, as described by W. Koechner in *Solid-State Laser Engineering, Second Edition*, pp.389-399. As shown in Figure 1, the slab geometry provides a large cooling surface relative to a cylindrical rod of equal volume. The heat flow within the slab is essentially one dimensional and is spread over a large area, therefore the temperature gradient is small relative to the rod and is also one dimensional. Because the stress within the slab follows the temperature gradient, the stress-induced birefringence tends to be along the normal to the broad slab surfaces and light polarized in this direction or an orthogonal direction will not be depolarized when propagated through the slab. The thermal lensing in the slab is cylindrical and can be compensated by propagating the beam in a zig-zag path between the large slab surfaces, as shown in Figure 1. The zig-zag slab laser was first disclosed by W. S. Martin and J. P. Chernoch in U.S Patent 3,633,126, issued Jan 1972, and assigned to the General Electric Corporation. The theory of operation and limitations of the zig-zag slab are described very completely by Koechner (ibid) and are not repeated herein.

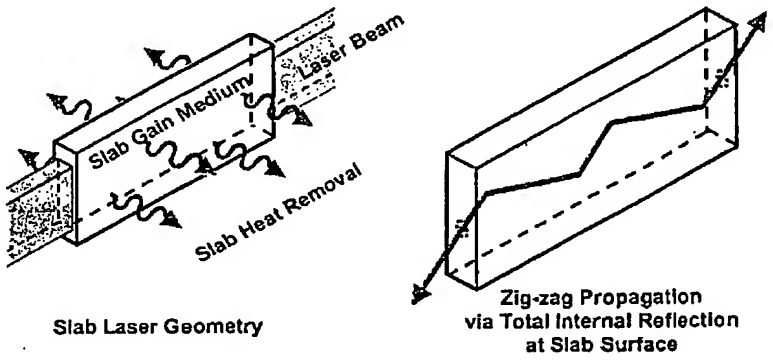

Figure 1. Solid-state Slab Laser Configuration

Military lasers are frequently designed with porro prisms, Benson prisms, and/or corner cubes to minimize the sensitivity of the laser output to misalignment or vibration in one or two axes. The porro (or roof) prism is insensitive to misalignment when rotated about the fold axis. The Benson prism, which combines a Porro prism and 90° reflecting prism in a single element, provides similar misalignment insensitivity and preserves the incident beam polarization. The corner cube is insensitive to misalignment when rotated about either axis orthogonal to the retroreflection direction. Crossed porro and Benson prisms have been used extensively in rod laser resonators to provide alignment insensitivity in both axes. Because the beam profile is flipped by the fold, radial assymetries in the resonator optics and in the rod gain medium are homogenized on successive passes, leading to more uniform beam profiles in the near

INVENTOR(S) SIGN AND DATE:					
	10/1/02		10/1/02		10/1/02
WITNESS NAME (PRINT) Maurice J. Halmos	WITNESS SIGNATURE	DATE 10/3/02	WITNESS NAME (PRINT) Douglas A. Anderson	WITNESS SIGNATURE	DATE 10/1/02

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and far field. This crossed-porro approach is particularly advantageous when used with a pockels-cell Q-switch and polarization output coupler, as shown in Figure 2, wherein the output coupling fraction is readily controlled by rotating the prism nearest the rod.

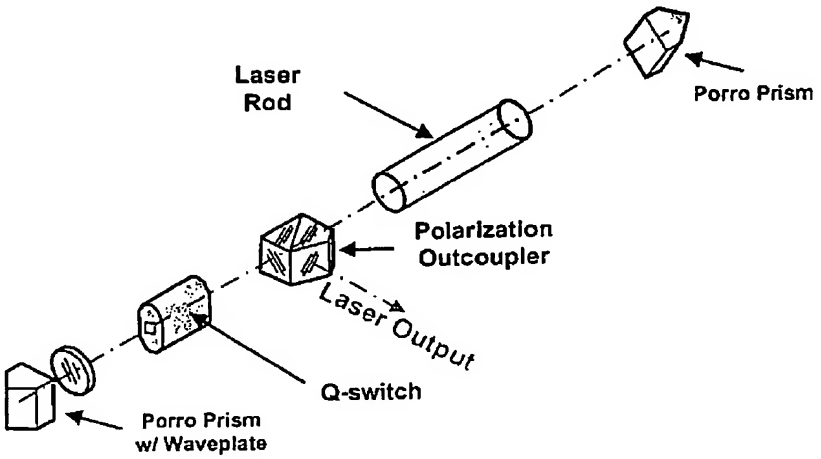

Figure 2. Crossed-porro Laser Resonator with Polarization output coupling

The standard technique to achieve high beam quality in a stable laser resonator configuration is to place a limiting aperture within the resonator that is lossy for high-order transverse modes. The parameter used to quantify the transverse mode discrimination in a resonator is the Fresnel number, which is discussed by Koechner (ibid, pp. 180 - 190). The Fresnel number is given by:

$$N = a^2 / \lambda L$$

where: N = Fresnel number
a = diameter of limiting aperture
λ = wavelength of laser light
L = optical length of laser cavity

If the Fresnel number is high, the higher-order modes are less lossy and able to achieve the threshold condition for lasing. The resultant beam quality of such a multi-transverse-mode laser is poor. If the Fresnel number is very low, even the lowest-order modes experience high loss and will not lase, resulting in no laser output. Typically, lasers operating exclusively in the lowest-order TEM_{00} mode will have Fresnel numbers in the 0.5 to 2.0 range, according to Koechner.

Detailed Description of Present Invention:

The present invention uses a porro or Benson prism in conjunction with a slab laser medium within a laser resonator to (1) homogenize the beam profile in the near and far field and/or (2) take advantage of the low Fresnel number in the thin dimension of the slab to improve the beam quality in both transverse beam directions. An illustrative embodiment of this laser resonator configuration is shown schematically in Figure 2. A high aspect slab of ytterbium-doped yttrium aluminum garnet (Yb:YAG), that is pumped through its side or end faces with indium gallium arsenide (InGaAs) laser diodes (not shown), serves as the laser gain medium. An intracavity telescope expands the beam in the narrow dimension and compresses the beam in the wide dimension of the slab such that the beam is the same size in both dimensions as it enters the porro prism and is approximately the same intensity everywhere within

INVENTOR(S) SIGN AND DATE: 10/1/02			10/1/02		10/1/02
WITNESS NAME (PRINT) Maurice J. Halmos	WITNESS SIGNATURE	DATE 10/3/02	WITNESS NAME (PRINT) Douglas A. Anderson	WITNESS SIGNATURE	DATE 10/1/02

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the resonator. The telescope is located at some distance from the limiting aperture of the slab in order to minimize the Fresnel number of the resonator. The porro prism is rotated 45 degrees about the optical line-of-sight with respect to the slab axes. In this embodiment, a conventional polarization beamsplitter is used as the resonator outcoupler. Other outcoupler techniques, however, may be used without departing from the spirit and scope of this invention.

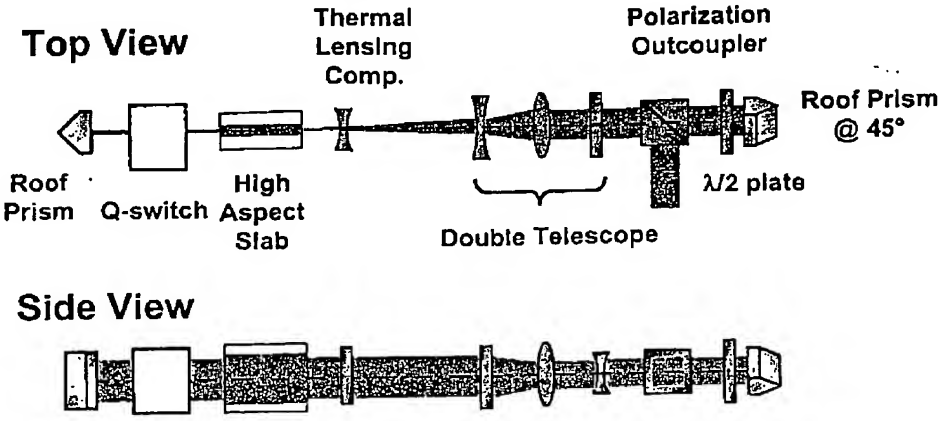

Figure 3. Inventive Slab Laser with 45°-rotated Porro Prism and Interacavity Telescope.

The heart of this invention is the combination of a slab laser medium, an anamorphic telescope, and a porro or Benson prism rotated 45 degrees about the optical line-of-sight with respect to the slab axes. This novel assembly of conventional components provides two major advantages in laser resonator performance. First, the assymetry in both the near field and far field beam profile associated with the aspect ratio of the slab is corrected by rotating the image of the beam by 90° on successive passes through the laser resonator. This produces a very symmetric beam profile and a very uniform beam quality along both slab axes. Second, high beam quality is achieved along both slab axes by forcing both beam directions to experience a low Fresnel number on alternate passes through the thin dimension of the slab and its associated limiting aperture.

There are several important applications where this invention is particularly advantageous. The first is a short-pulse, high beam quality power oscillator. A short resonator length is typically required in a Q-switched system to minimize pulse buildup time. Conventional slab lasers, however, require a long resonator length to maintain a low Fresnel number in the wide dimension of the slab. While intracavity telescopes can be used to reduce the effective aperture of the beam within the resonator (thereby reducing the Fresnel number), this places high peak optical intensity on the coated optical surfaces of the telescope, which can damage these surfaces. The present invention uses an anamorphic telescope that does not appreciably change the peak intensity, while providing a low Fresnel number on alternate passes. Furthermore, achieving a low Fresnel number in the wide dimension of a conventional slab resonator may reduce the Fresnel number in the thin dimension to a very lossy regime, where lasing action either would not occur or at best would be very inefficient.

The second application is a CW oscillator with a circular clear aperture that must produce a symmetric spot in the far field. This is difficult to achieve in a conventional slab laser resonator due to the assymetry in the slab. The present invention corrects this assymetry by rotating the beam on successive passes. The result is a symmetric beam both in the near field (optimal for a circular clear aperture) and in the far field and a homogeneous beam quality in both transverse directions.

INVENTOR(S) SIGN AND DATE: 10/1/02 Robert Reeder 10/1/02 David Flagg 10/1/02					
WITNESS NAME (PRINT) Maurice J. Halmos	WITNESS SIGNATURE	DATE 10/3/02	WITNESS NAME (PRINT) Douglas A. Anderson	WITNESS SIGNATURE	DATE 10/1/02

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Figure 4 shows one specific embodiment of the present invention in a short-pulse laser radar (ladar) application. A dual mode EO switch is used with a relatively long 4-fold resonator to achieve cavity dumping of a mode-locked waveform. The dual mode EO switch is driven by a voltage waveform that provides high holdoff during an initial period (which allows high gain to build in the laser medium without extraction), followed by a sinewave-modulated high transmission period (which allows a single mode-locked pulse to build within the cavity), followed by 100% output coupling (which allows the pulse to be extracted via the polarization outcoupler). A resonant reflector is used to limit the number of longitudinal modes propagating in the resonator, which determines the mode-locked pulse duration (the pulsewidth roughly equals the cavity round-trip time divided by the number of longitudinal modes). The theory of operation of a mode-locked laser resonator is described in detail by Koechner (ibid, pp. 451-454). This approach has several advantages over conventional Q-switching. First, very short pulse widths can be achieved with a relatively low-gain medium such as Yb:YAG. Second, the intracavity optical flux is only about 1.4 times the output flux resulting in lower optical damage and higher reliability. Finally, the short pulse duration is not dependent on a short round-trip propagation time within the cavity, therefore a long cavity can be used to provide very good beam quality (low Fresnel number). A long cavity is also advantageous in providing time to cavity dump the circulating mode-locked pulse.

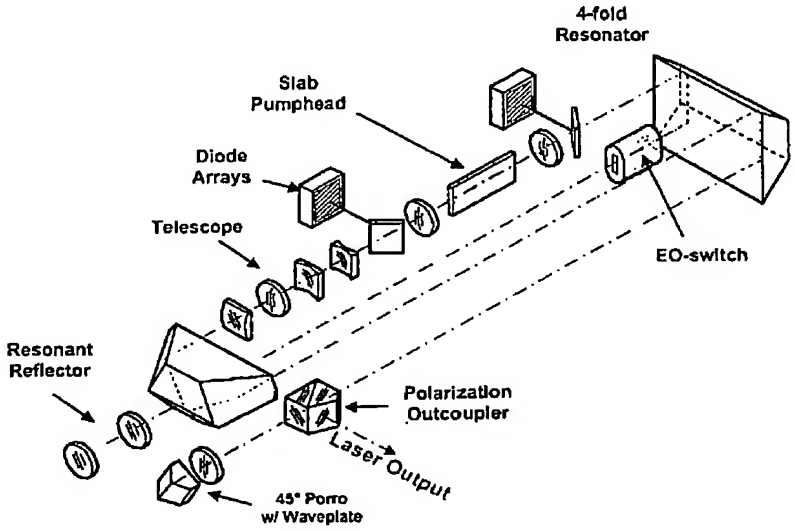

Figure 4. Short Pulse Mode-locked and Cavity Dumped Resonator using Present Invention

INVENTOR(S) SIGN AND DATE: 10/1/02 Robert A Reed 10/1/02 David Flegs 10/1/02					
WITNESS NAME (PRINT) Maurice J. Halmos	WITNESS SIGNATURE	DATE 10/3/02	WITNESS NAME (PRINT) Douglas A. Anderson	WITNESS SIGNATURE Dagl A. Anderson	DATE 10/1/02

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Robert W. Byren

Joseph W Stone
11/05/2002 05:23 PM

To: Robin A Reeder/RWS/Raytheon/US@MAIL, David M Filgas/RWS/Raytheon/US@MAIL, Robert W Byren/RWS/Raytheon/US@MAIL
cc: Colin M Raufer/RWS/Raytheon/US@MAIL

Subject: PD-02W189 - Slab Laser and Method with Improved and Directionally-Homogenized Beam Quality

Dear Inventor:

Your above-identified invention disclosure was reviewed by the ES El Segundo South Invention Evaluation Committee on October 23, 2002. As a result of this meeting, the Committee decided that a patent application would be filed on your invention. You will be contacted by the outside counsel for your assistance in preparing this application.

Certain acts by an inventor or others, such as public use, offer for sale, or publication of an invention prior to the filing of a patent application in the U.S. Patent and Trademark Office, can adversely affect patentability both in the United States and foreign countries. Please notify me before engaging in any activities of a public or commercial nature regarding this invention so that we may preserve our patent rights in the subject invention.

Thank you for submitting your invention disclosure and for assisting us in its evaluation.

Please keep us informed of any further developments regarding this invention.

Joseph W. Stone
for Colin M. Raufer, Esq.

BENMAN, BROWN & WILLIAMS
ATTORNEYS AT LAW
2049 CENTURY PARK EAST, SUITE 2740
LOS ANGELES, CALIFORNIA 90067

INTELLECTUAL PROPERTY
& RELATED CAUSES

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VIA PRIORITY MAIL

Robin Reeder
David M. Filgas
Robert W. Byren
Raytheon Company
Bldg. E1 M/S D109
P.O. Box 902
El Segundo, CA 90245

April 1, 2003

Re: Preparation of a Patent Application for PD-02W189
SLAB LASER AND METHOD WITH IMPROVED AND DIRECTIONALLY HOMOGENIZED BEAM QUALITY
Inventor(s): Robin A. Reeder, David M. Filgas & Robert W. Byren

Gentlemen:

Enclosed is a draft of the patent application on the invention of the above-identified disclosure along with copies of the informal drawings.

Please review the application in detail for technical accuracy and completeness. It would be most convenient if you would provide your changes directly on the copy of the application stored on the enclosed floppy disk in Word 2000 format. Please save your changes using the next progressive numerical extension (*.pa3). We will create a compare draft on our end. We have also made available a text file in the event that the Word 2000 file can not be opened on your end.

Please provide us with your comments within two weeks from the date of this letter. If you have any additional questions regarding this application, please do not hesitate to call.

We understand that there has been no activity (publication, public use, offer for sale, or sale) on your invention that would give rise to a statutory bar date. If you have reason to believe that this may not be the case, please advise us or Corporate Patents as soon as possible.

Sincerely,

William J. Benman

WJB/lc
Enclosures

cc: C. Raufer, Esq., (w/encls.)

Leigh Christian

From: William J. Benman [wbenman@pacbell.net]
Sent: Friday, June 13, 2003 12:40 PM
To: Robert W Byren
Subject: Re: PD-02W189

Thanks Bob.

----- Original Message -----
From: "Robert W Byren" <rwbyren@raytheon.com>
To: <wbenman@pacbell.net>
Sent: Friday, June 13, 2003 11:11 AM
Subject: PD-02W189

>
>
>
>
> Raytheon Proprietary
>
> Dear Bill,
>
> David Filgas, Robin Reeder and I reviewed the draft patent
> application you sent entitled "Slab Laser and Method with Improved and
> Directionally Homogenized Beam Quality." Our edits are included in the
> attached Word document. The relatively minor edits are permanent and the
> major edits and all changes to the claims are in Track Changes mode. A
> PowerPoint document is also attached which includes revisions to the
> artwork (with no callouts), and dialog boxes are added to identify the
> major changes (these can be deleted in Powerpoint).
>
> If you have any questions, please e-mail me or call at (310)
> 647-1375.
>
> Regards,
>
> Bob Byren
>
> (See attached file: PD-02W189.pa4.doc)(See attached file: SBQI_art2.ppt)
>

BENMAN, BROWN & WILLIAMS
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VIA PRIORITY MAIL

October 16, 2003

Re: Preparation of a Patent Application for PD-02W189
SLAB LASER AND METHOD WITH IMPROVED AND DIRECTIONALLY HOMOGENIZED BEAM QUALITY
Inventor(s): Robin A. Reeder, David M. Filgas & Robert W. Byren

Dear John:

Enclosed for filing is a final draft of a patent application on the invention of the above-identified disclosure along with formal drawings. A copy of the application is provided on the enclosed 3.5" diskette in Word 2000 format.

Also enclosed are four (4) sets of photocopies of the formal drawings on smooth surface, calendar-finish paper without watermarks for the above referenced case.

Please call me if you have any questions or comments or if I may provide any other service in connection with this matter.

Best regards,

-Bill

William J. Benman

WJB/lc
Enclosures